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Contents for Week of April 18, 1927. Vol. VI. No. 8.

1. The Engineering Wonders of the World.
2. Amoy: Where Boston's "Tea Party" Ship Came From.
3. Our State Park Systems.
4. United States Owns Biggest, and Least Harmful, Volcano Chain.
5. Why Aviators Must Wait on the Weather.

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A BUFFALO-DRAWN DISK-WHEEL CART OF ANATOLIA

The wheel, which we take very much for granted, is considered one of the greatest inventions of all time. For thousands of years oxen dragged their cargoes, and it must have been thousands more before a four-wheel vehicle was invented. Think how recent are our modern carriers, the railroad, the steamship, the auto truck and the airplane.

HOW TEACHERS MAY OBTAIN THE BULLETINS

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The Engineering Wonders of the World

CONSTRUCTING an international suspension bridge, linking Detroit, Michigan, with Windsor, Ontario, is to begin this month. This span, which will be one of the longest in the world, adds another engineering wonder to those already scattered over the face of the earth.

The accomplishments of civilization most easily noticed are in large part engineering projects.

Many Structures Would Be Visible from the Moon

So indefatigably has man busied himself making over his environment that much of his handiwork would stand out to an observer posted on the moon with a telescope equal to our best. The irregular splotches of our cities with their straight lines would show up all around the world. Here and there railroads and their cuts and clearings would catch the eye as would some long, straight stretches of highway.

The most ancient of the earth's great structures, the Pyramid of Cheops, should be plainly visible, especially when two sides are in shadow; and the moon observer could probably pick out that other old engineering triumph, the Great Wall of China, snaking its 2,500 miles over mountains and valleys. Few canals, probably, would appear to such a hypothetical survey from the moon, since they would be indistinguishable, for the most part, from natural streams.

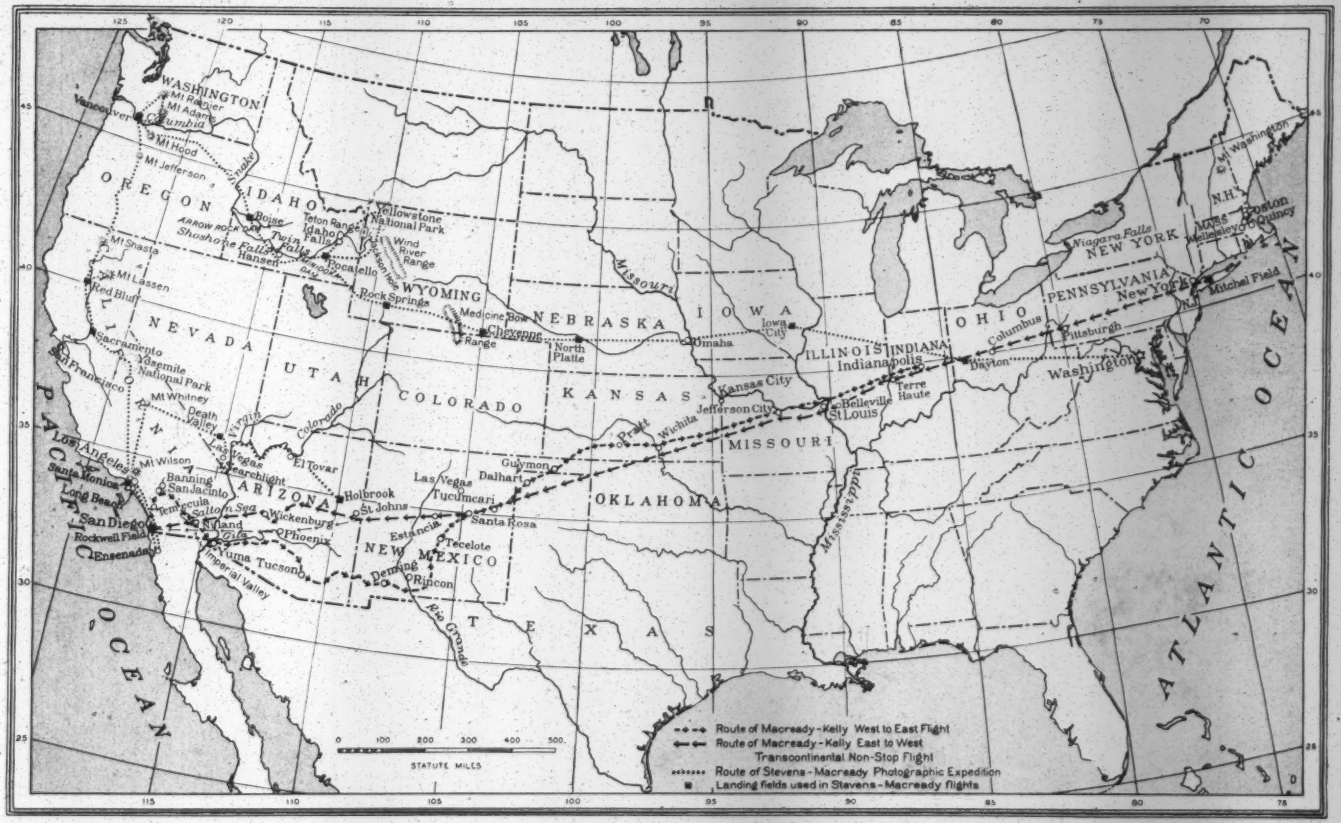
The observer who seeks evidences of man's reshaping of the earth will find them on every hand. On our own continent and in Europe, especially, a veritable network of railways and roads lies over the countryside. Most major streams are spanned by bridges or made by dams to stand and deliver water for irrigation or power. A goodly number of our hills and mountains have been honeycombed by the shafts and galleries of mines, or pierced by railway tunnels. Man has even burrowed his way under great rivers to make way for city transit lines, railways, vehicles and foot passengers.

Cities Are Never-Finished Engineering Projects

Every great city is itself a huge and never-finished engineering task. There are few residents of New York or London or Paris who would not be surprised, if cross-sections of their city could be laid bare, at the complexity of its underground facilities, its multiplicity of subways, water tunnels and pipes, wire-conduits and sewers.

Above ground buildings are constantly being erected and demolished, railways repaired, pavement laid. Galveston, Texas, owes its continued existence to a great granite sea-wall; New Orleans, to its levees. Venice and Leningrad rise in large part from a multitude of piles driven into mudbanks; and other cities in various parts of the world must credit engineering skill for their sites or for their protection.

One of the most striking debts of a country to engineering is to be found in The Netherlands. The country's name hints at the story; nearly half its area lies below the level of the sea which is kept from engulfing the lowlands only by hundreds of miles of man-made dikes and sluice-gates. And only constant watchfulness and work keep this below-sea-level country habitable. Embankments



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ROUTES FOLLOWED BY LIEUTENANT JOHN A. MACREADY AND LIEUTENANT OAKLEY G. KELLY IN THEIR TRANSCONTINENTAL, NON-STOP FLIGHTS, AND OF LIEUTENANT MACREADY AND LIEUTENANT A. W. STEVENS ON THEIR LATER PHOTOGRAPHIC FLIGHTS

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Amoy: Where Boston's "Tea Party" Ship Came From

AMOY, CHINA, once China's greatest tea port, appears in recent news dispatches as a safety zone for American missionaries in Fukien province.

Amoy, however, has a far older contact with the United States than its present service as a refuge center. It was from Amoy that the ship sailed in 1773 which some months later figured in the historic "Boston Tea Party."

Going farther back than that, Amoy was one of the earliest Chinese cities to come in touch with western civilization. The Portuguese established themselves there in 1644 but were expelled before long. The British then began operations in Amoy and continued trading through that port exclusively until 1730, when they were ordered to change to Canton. For a long time Amoy was the world's leading port in tea exportation, but for a century this trade has been declining.

Loss of Formosa Was a Blow to Amoy Trade

The greatest blow to Amoy trade came in 1894 when Formosa, just off the Chinese coast from Amoy, was taken from China by Japan. Formosan tea and other products had reached the world through Amoy. Since Japan took over the big island its own ports have been developed, and trade worth millions of dollars annually has been lost to Amoy.

Amoy is still a big city, however, with a population of about 150,000. And nothing can take from it the distinction of having one of the best harbors on the Pacific. Like Hongkong, the town is situated on an island, Amoy Island, which has a circumference of 35 miles. The nearest peninsula of the mainland is 3 miles away. The arms of the island and the mainland enclose a large bay whose mountainous shores and islets make this body of water one of the picturesque spots of the Chinese coast. Outside Amoy Island a string of islands, stretching north and south, forms an excellent natural breakwater which adds to the value of Amoy's great, deep harbor.

The native city of Amoy has two parts, the old and new cities, divided by a low range of hills topped by old battlements. The site of both is the steep slope of a larger hill which rises to barren, boulder-capped summits behind the town. The streets are narrow, steep affairs in which no vehicles but sedan chairs can be used. Even the grandiloquently named "Chuanchow Highway" is little more than a footpath over which an occasional donkey picks his way.

Had Dubious World's Record

Amoy formerly was accorded a world's record, but it is not shouted about by proud citizens. Many travelers asserted that in dirtiness and insanitary conditions Amoy was the Abou ben Adhem of cities. Because of this situation Amoy was frequently visited by cholera and plague.

There is a great gulf in the matter of conditions—and half a mile of salt water—between Amoy and its foreign settlement. This is on Ko-long-su, a small island which lies between Amoy and the mainland. With its consulates and residences built among shady groves, its schools, hospital, churches, and hotels, and above all with its sanitation along western lines, this little oasis is known as "the Paradise of South China."

must be patrolled and repaired constantly. Seepage continues night and day and pumps must be kept operating continually to lift millions of gallons of water from the lowest catchment basins to canals high enough to carry it into the sea.

Canals were among the earliest important engineering projects undertaken by man. Near the dawn of history some 6,000 years ago, great irrigation canals that were virtually artificial rivers existed in the valleys of the Tigris and Euphrates rivers in Mesopotamia. They were demolished by Mongol invaders 700 years ago, but traces of the huge channels still remain. In Egypt a ship canal connecting the Nile and the Red Sea was dug 2,000 years before Christ. In the 5th century B. C. the Chinese began their Grand Canal, finished seventeen centuries later. This 850-mile waterway is the oldest and longest boat canal in existence.

Dams Are Recent Devices

All the earlier canals were inland. Not until 1869, when the Suez Canal was completed, did the world possess an inter-ocean waterway. Its only rival has been the Panama Canal, opened in 1914. These two waterways between the oceans, one costing $127,000,000 and the other more than twice that much, probably deserve to rank at the top of the world's engineering achievements.

Dams are relatively recent devices, in so far as large streams are concerned. No word of dam-building operations of any magnitude has come to us from the records of the ancients. Large dams were built in Spain in the latter part of the 16th century and in France and Spain in the 17th and 18th. In the 19th century dam building spread to the rest of Europe and Great Britain, North Africa, Asia, and the United States.

Two of the largest dams are in Egypt. The Aswan, across the Nile, is 1¼ miles long and 113 feet high. The Sennar, across the Blue Nile, is the longest masonry dam in the world—9,900 feet, or nearly 2 miles. Its height is 128 feet. The longest of all is the earthen Ashti Dam in India which is 12,709 feet in length. It is only 58 feet high.

The Present Is the Greatest Highway Era

Road construction received little attention from the ancients and did not become an important activity until the advent of the Romans. When the Roman Empire died road-building died with it, not to be galvanized into life again until the 18th and 19th centuries. The present is the greatest road-building age that the world has seen. Each year many hundreds of millions of dollars are absorbed in the construction of highways, chiefly in the United States, Europe and the colonial possessions of the great powers.

Tunnel boring has had both ancient and modern aspects. The Egyptians dug tunnel entrances to temples and tombs, or hollowed the latter bodily from the rock. The Greeks, as early as 500 B. C., are said to have constructed galleries in mines. The Romans anticipated the modern world, using tunnels to conduct water supplies, to drain lakes, and even to carry roads through obstructing ridges. Extensive tunnels were first built in Europe, after the Roman era, in the 17th century when portions of canals were carried through tunnels.

The 19th and 20th centuries increased tunnel building by the demands of cities for water supplies, land for irrigation, and the needs of railroad construction. The largest tunnel in the world carries the Rove Canal of southern France for 4½ miles through hills. Its bore is 72 feet wide and 47 feet high. The longest of all tunnels are of relatively small bore and are for carrying water. Two of the New York City water system and one in the new San Francisco water system are approximately 18 miles long. A tunnel draining a mine in Saxony is almost exactly the same length. The three longest railway tunnels in the world are in the Alps. Lootschberg is 8 miles long; St. Gothard, 9 1/4; and Simplon, 12 1/3.

A unique engineering project of great magnitude was the laying of the huge conduit of the Los Angeles water system, carrying virtually a small river across 250 miles of desert. It was completed in 1912 at a cost of more than $20,000,000.

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Our State Park Systems

WHAT are state parks?

The forthcoming meeting of the Seventh National Conference on State Parks at the Palisades Interstate Park, May 17 to 20, gives rise to the question.

Reference books will tell much about national parks and city parks; only very recent ones will have much to say about state parks.

Here Are a Few Definitions

State parks are pocket editions of our great National Park system.

They are the stop-over places of the motorist.

They perch on barren peaks and preserve tree-bowered lovers' lanes beside running brooks.

They take in such shrines as Lincoln's birthplace and James Whitcomb Riley's "old swimmin' hole."

They perpetuate far older history than that to be found in history textbooks. Starved Rock Park, Illinois, commemorates the time when America's inland was a sea; when the happenings of millions of years ago deposited the shells and precipitated the lime which formed the magnesium limestone layer of this region.

"Prairie Land to Fairyland"

Iowa invited its citizens to an hour's auto ride from "prairie land to fairyland."

In Wisconsin you can rent an island for ten dollars a year.

State parks save the open play spaces amid dense populations of the East and they keep out encroaching farm lands of the Middle West.

Rip Van Winkle sought surcease in skittles from a shrewish spouse, but the city man to-day, harried by a hundred worries, can take wife and children for a 48-hour rest to the hills where Rip retreated.

If this sounds like rhapsody—that's what state parks still afford to routine-ridden city dwellers.

Our own parks bear evidence of our new governmental ideal. Originally a park, says Noah Webster, was "an inclosed piece of ground stocked with beasts of the chase, held by prescription or the king's grant."

To-day a park might be defined as "an uninclosed piece of ground stocked with beasts, not to be chased, or killed, held by prescription of the people for their own use."

How Niagara Set a Park Precedent

Niagara Falls is nationally known as scenery, and also as a controversy, but, in the history of the park movement, Niagara is a precedent. It was the first public reservation in the United States acquired by condemnation and purchased with public money for the sole purpose of preserving natural scenery; a proceeding which was thereby accounted a legal use of public funds.

Hartford has a park which is an early example of the best sort of civic publicity and also established a park precedent. Search your memory and see whether you have not forgotten most of the statistics and slogans which greet you upon huge signboards placed along the railway tracks by trade bodies of many enterprising cities. But nobody who has entered Hartford by train, in daylight,

Open Door for Emigrants

Amoy is a great gateway for coolie emigration, especially to Singapore and the East Indies. About 75,000 natives embark at Amoy each year, and only a small part of this number returns. Nearly every family in Amoy has one or more members abroad, and, since the decline of the port's trade, economic disaster is staved off largely by the remittances sent home by these expatriates. This "tribute" to Amoy amounts to more than $12,000,000 annually.

The largest and deepest draft vessels in the world can be accommodated easily in Amoy's commodious harbor. Because of its excellent harbor facilities, Amoy was selected by the Chinese Government in 1908 as the port at which to receive and fete a section of the United States fleet then on its famous trip around the world.

Bulletin No. 2, April 18, 1927.

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TEA PICKERS OF JAPAN

These girls are wearing long sleevelets or gloves to keep their hands and arms from being scratched.

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United States Owns Biggest, and Least Harmful, Volcano Chain

RECENT signs of renewed volcanic activity in the region of Mount Katmai, Alaska, is a reminder that, in the Alaskan Peninsula and the Aleutian Islands, the United States owns one of the most active volcanic regions in the world.

Not so long ago it was Mount Redoubt, Alaska, that was rumbling. That volcano's activities are watched with keen interest because it is not remote from the settled portions of Alaska. It rises close to the western shore of Cook Inlet, at the head of which is Anchorage, an important port on the Alaska Railroad recently constructed by the Federal Government.

This mountain and a companion peak, Iliamna, are conspicuous landmarks for ships which steam up Cook Inlet. They are almost perfect cones, and with their snow-covered caps serve very well as American versions of the famous Fujiyama of Japan. Redoubt forms, so far as is now known, the landward end of the long chain of volcanoes which stretch to the southwestward along the Aleutian Islands for more than 1,200 miles, and which have been spouting fire at intervals for hundreds of thousands of years.

Mountains That "Blow Their Heads Off"

These volcanoes have a disconcerting way of "blowing their heads off" with little warning. Katmai, 200 miles to the south, which is one of the chain that had long been dormant, exploded suddenly in 1912, constituting one of the dozen greatest eruptions of historic times. A scientific expedition sent to the crater by the National Geographic Society found that two cubic miles of material had been blown from this previously passive mountain. It was while making a study of Katmai that The Society's expedition found that unique natural phenomenon, "The Valley of Ten Thousand Smokes."

Augustine Mountain, in Cook Inlet, less than 100 miles from Redoubt, and long noted for its perfect cone, blew its top off suddenly in 1883, leaving only a jagged stump.

The whole Alaskan volcanic chain is a unit of volcanic action, and it is always problematical where the next outburst will occur.

Why Alaskan Eruptions Are Welcome—and Harmless

To scientists one of the significant features in connection with the existence of the extensive volcanic region in Alaska is the fact that it is situated where, in the future at least, it will be easily accessible for study. Moreover, the area is so thinly populated that eruptions entail little danger. And there is much room for the study of volcanoes. Although volcanism was probably one of the first of Nature's spectacular phenomena to thrill man, it presents one of the few obvious problems about which science has no satisfactory hypothesis. Just where the heat comes from which melts stone, why it is concentrated within definite areas, from what depths the molten material rises and why it rises—these are some of the problems about which there has been much speculation but in regard to which few satisfactory theories exist.

Telltale fossils and types of rock show that the mountains of the Alaskan peninsula and the Aleutian Islands are older than either the Himalayas or the

is likely to forget the sylvan beauty of Bushnell Park, which adjoins the station, with the tree-shaded Connecticut Capitol building set on its central hill.

Horace Bushnell worked for five years to persuade his neighbors to tax themselves to buy this tract. Thus Bushnell Park is a monument marking the first time in history when the people bought a tract with their own money to be used as a public park.

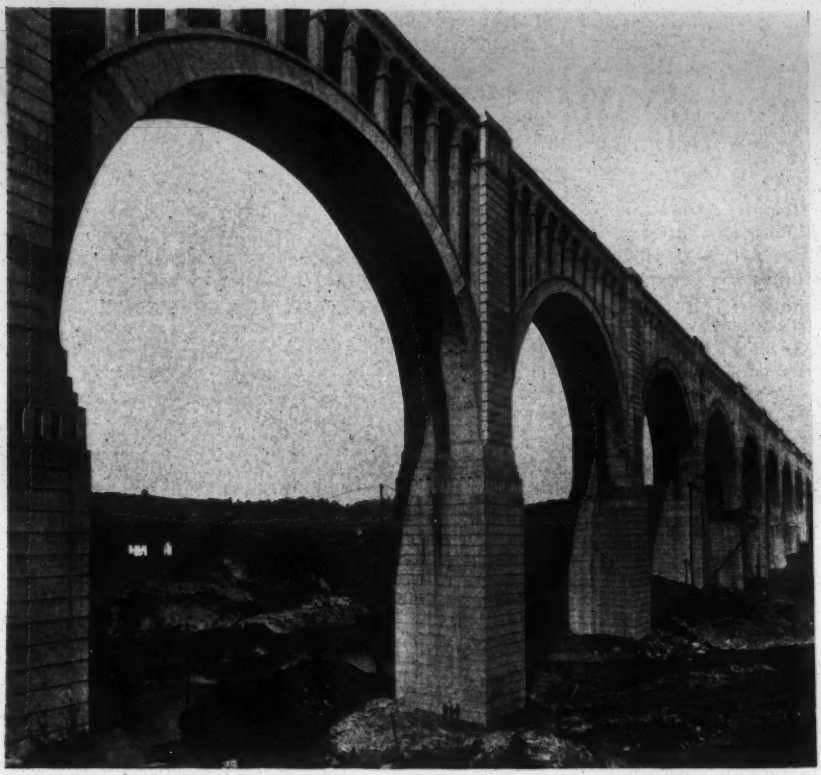
A Reversal of Purpose

Exactly opposite to the days when feudal barons used a park to keep the public out is the era when the essential element of a park is that King Auto and Sovereign Pedestrian must have easy access. Colorado proclaims that she has a motorists' camp in every town of a thousand or more people. Iowa avers that she has more camp sites per capita than any other state.

New York, with forty reservations, comprising more than 2,000,000 acres, heads the list of states in the extent of her park system. Ten million people, it is estimated, can reach the Palisades Interstate Park in a two-hour ride by auto or boat.

Nowhere are parks longer regarded as luxuries; but in New York State they are an additional necessity because they protect the vitally important watersheds in the north of the state. Upon this protection depend the great industrial enterprises which use hydro-electric power.

Bulletin No. 3, April 18, 1927.



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THE VIADUCT ACROSS THE TUNKHANNOCK, IN PENNSYLVANIA

The apparent slenderness of the piers of this bridge is due to their great height. The men standing under the foreground arch give some idea of the viaduct's vast proportions. Bridges were among the earliest, and still are among the most essential, of mankind's engineering achievements (see Bulletin No. 1).

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Why Aviators Must Wait on the Weather

MONTH by month some aviator has the world's eye on him for launching a flight to achieve some new record. Frequently the public becomes impatient at reports that the start has been "delayed by weather conditions." There always is a reason for such postponement.

Just how necessary it is to consider the essential factor of weather conditions is attested by Lieut. John A. Macready, U. S. A., one of America's most daring aviators. In his diary of the first non-stop flight across America, made with Lieut. Oakley G. Kelly, Macready wrote:

"The majority of people probably think that all we had to do to make the flight was to climb into the plane, start across, and trust to luck. But transcontinental non-stop flights and endurance records are primarily made on the ground. Success or failure depends largely on the work and preparation that is done before the plane takes the air.

Must Fly "with the Weather"

"Wind and weather must be studied and the nature of the flight arranged to benefit by these agencies.

"Bad weather in the daytime would not bother. We would have started in a rainstorm, had the winds been right and the conditions at night favorable.

"We dreaded storm conditions over the mountains at night. No one had ever flown across country under these circumstances, and we did not know whether or not a plane would be beaten to the ground.

"We would take the best that we could get, but we hoped for a full moon, clear sky, and strong tail wind. A start would have been made in the dark of the moon had all other conditions been ideal.

How Weather Reports Were Arranged

"When the transcontinental flight was first contemplated, the prospective pilots conferred with the Chief of the Weather Bureau at Washington to ascertain what simultaneous weather conditions might be expected over such a large area, to receive information and data regarding the speed and direction of prevailing winds, and to get expert advice respecting the most logical starting point, whether from the east or west coast.

"Weather maps over a period of years showed an average wind velocity from west to east during the month of October of 22 miles per hour. Taking this fact into consideration, the chief forecaster, Major E. H. Bowie, recommended that the direction of flight be toward the east.

"After October 10 there was practically no moon. Had all weather conditions and winds been ideal, the pilots would have attempted the flight during this period of total darkness, as the cold of winter, long nights, and uncertain weather were hazardous.

"All was in readiness to start on short notice; in fact, two starts were anticipated during this time, and the airplane was brought out at night to the end of the runway with the expectation of a take-off in the morning; but later weather reports were unfavorable and it did not appear good judgment to leave under such conditions.

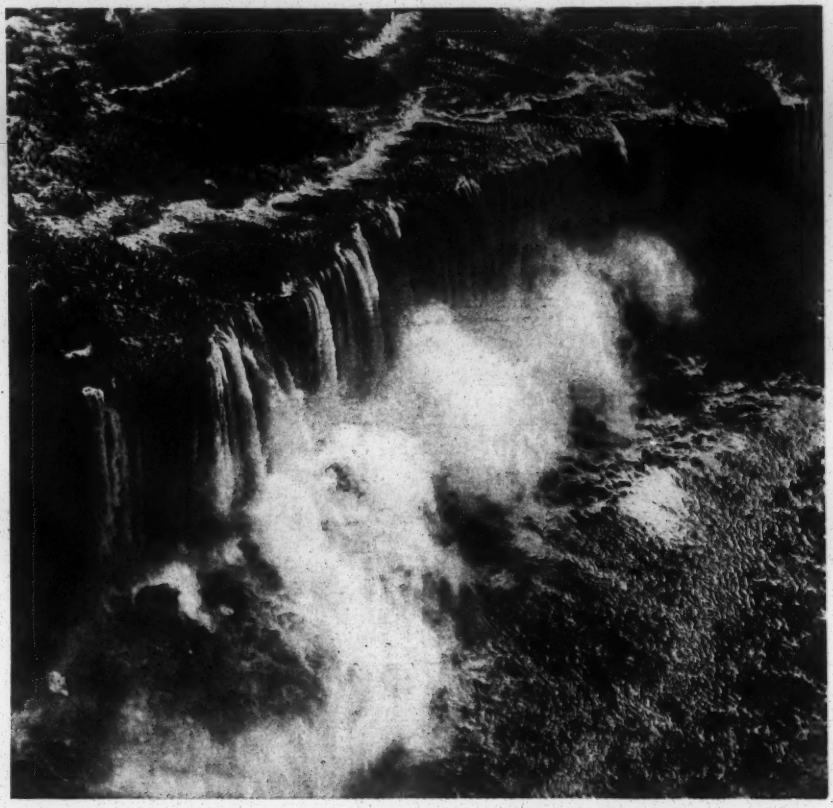
Alps, systems which are practically without volcanoes. It does not follow, however, that volcanic activity accompanies age, for the Appalachians, among the oldest mountains of the earth, have no volcanoes.

Bulletin No. 4, April 18, 1927.

For a complete account of the eruption of Mt. Katmai and the discovery of the Valley of Ten Thousand Smokes, revealing many of the secrets of forming earth crusts and bringing back plant life to a vast devastated area, see "The Valley of Ten Thousand Smokes," by Robert F. Griggs, leader of the Katmai-Alaska expeditions of the National Geographic Society. The volume may be consulted in your school library or your public library.

For further material about China (Bulletin No. 2) see, in the *National Geographic Magazine:* "The Chinese: Farmers Since the Days of Noah," by Adam Warwick, April, 1927; "The Man in the Street in China," by Guy Magee, Jr., November, 1920; and "A Thousand Miles along the Great Wall of China," by Adam Warwick, February, 1923.

For two narratives of remarkable airplane voyages (Bulletin No. 5) see, in the *National Geographic Magazine,* "The Non-Stop Flight across America," by Lieut. John A. Macready, July, 1924, and "From London to Australia by Aeroplane," by Sir Ross Smith, March, 1921. Both articles contain many aerial views of physical features not hitherto taken.



Official Photograph, U. S. Army Air Service

AS THE AIRMAN SEES THE AMERICAN FALLS AT NIAGARA

This portion of the famous scenic wonder lies within a State Park, one of the rapidly multiplying reservations which Commonwealths are setting aside for the tourist, the camper, and the nature-lover. It marks the first place in the United States where condemnation proceedings were employed for the sole object of preserving scenery (see Bulletins Nos. 3 and 5).

Waiting Was a Trying Period

"This period of waiting was a trying one. Few individuals enjoy good soft beds and good square meals more than Kelly and myself, but this was not the time to be loafing around San Diego, and we were getting desperate.

"Every time we stepped into an elevator at our hotel someone would ask us when we intended to start.

"It was all right for a week or so after the duration record, but later on, when the sun would be shining brightly in San Diego and Kelly and I would be making no apparent effort to go, we imagined that people would wink at their friends and say, 'Those two birds know a good thing when they get it. They haven't any idea of trying to get across this old continent. They'll spend a nice soft winter in San Diego and fly back by easy stages, when it's too late to make the non-stop.'

"They did not realize that at that minute there were rainstorms in the Middle West and in the mountains and high elevations that we would cross in darkness.

"A report from the chief forecaster at Washington on the morning of November 2 stated that weather conditions would not be propitious for a start within the next thirty-six hours. In the face of these reports, it was not expected that a start would be made the morning of November 3.

And Then the Forecasters Agreed

"But on the night of November 2, the San Diego weather forecaster, Mr. Dean Blake, brought his maps to the quarters of the pilots. Indications were for reasonably favorable weather with favoring winds for practically the entire route. At approximately 9 p. m. a report was received from the chief forecaster at Washington as follows:

"'Weather conditions propitious for start Friday morning. Saturday conditions will be less favorable.'

"With the two forecasters agreeing on an almost ideal condition, there was no reason for delay.

"I was giving an address to the University Club of San Diego during the course of their annual Duck Dinner, and Kelly received the reports at our hotel. He called me to the phone as I was finishing my talk. He said: 'Mac, have you got your passage booked for New York?' I answered that I had my ticket. 'All right; we start in the morning. Better get over here right away,' he said.

"I excused myself and left the dinner at 9:30 p. m. without intimating our decision. The next morning, when the university clubmen arose from their beds, their morning newspapers informed them that Kelly and I were well on our way across the continent. It must have been considerable of a shock to them, as the general opinion seemed to be that we were settled in San Diego for the winter."

The above description relates to an unsuccessful but remarkable attempt at crossing the continent. The successful flight was made from Long Island to San Diego, May 2 and 3, 1924.